MINISTRY OF BUSINESS, INNOVATION & EMPLOYMENT
HĪKINA WHAKATUTUKI

RESEARCH
EVALUATION
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UNCLASSIFIED

Modelled Territorial Authority Gross Domestic Product (MTAGDP)

2018 Methodology

New Zealand Government

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1. Summary

Since 2015, the Ministry of Business, Innovation and Employment (MBIE) has published experimental estimates of Modelled Territorial Authority Gross Domestic Product (MTAGDP). These provide information on regional GDP for New Zealand's 66 Territorial Authority (TA) areas. Stats NZ also publishes Regional GDP statistics for 15 Regional Council (RC) areas (Tasman and Nelson are combined). Stats NZ's Regional GDP series is an official Tier One statistic, whereas MBIE's MTAGDP series is experimental and its estimates should be regarded as indicative only.

As part of MBIE's efforts to continuously improve its data methods and quality, the MTAGDP methodology has been reviewed and revised for the release of MTAGDP data up to 2017 (the annual series covers the March years 2000 to 2016 for GDP by TA by industry groups, and also 2017 for total (not industry) GDP by TA). The main improvement has been to simplify the method involved. This has been enabled by the supply of custom Annual LEED (Linked Employer-Employee Data) earnings data from Stats NZ.

This document describes the new methodology and outlines the changes from previous releases.

1.1 Caveats and disclaimers

The main purpose of this product is to facilitate understanding of the Gross Domestic Product (GDP) of Territorial Authorities (TAs) in terms of output over time and by industry group. The estimates are best used as a tool to help understand the industrial makeup of these local economies, rather than as an annual monitoring tool. Given the proportionally large revisions that can occur in GDP estimates at the TA level, in part due to the relatively small numbers involved, they are not expected to serve as key performance indicators (KPIs) or targets for local governments or agencies.

The raw data used in MTAGDP is based on Stats NZ published and custom data, but the methodology was developed by MBIE. Stats NZ will not be held accountable for any error, inaccurate findings or interpretation within the MTAGDP results.

Due to the experimental nature of this product, it should be used with caution. While care and diligence have been used in developing the data for this product, MBIE cannot warranty it is error-free and will not be liable for any loss or damage suffered by the use, directly or indirectly, of it.

2. Methodology

2.1 Overall approach

MBIE developed the experimental MTAGDP series as a complement and extension of Stats NZ's Regional GDP series which is updated and published annually on the Stats NZ website. The Regional GDP series serves as the benchmark for the MTAGDP estimates. TA GDP estimate totals (and by industry totals) sum up to the Regional Council area GDP totals (and industry totals) in which they are contained (this is more problematic for TAs like Taupo, that crosses several RC boundaries – geographic share is used to apportion TAs to multiple RCs if they cross RC boundaries). The TA GDPs sum to RC GDPs because they are made to through a mathematical method called iterative proportional fitting (also known as bi-proportional scaling or raking).

Iterative proportion fitting (IPF) is applied to the earnings (wages and salaries) of people employed (it excludes earning of self-employed people) by TA by industry group. This data comes from a custom Annual LEED (Linked Employer-Employee Data) dataset provided by Stats NZ for the years 2000 to (at time of writing) 2016 (one year behind the 2017 year that Regional GDP currently runs to). The earnings from the custom Annual LEED data are used to estimate the relative size of GDP by TA by industry: essentially, the proportion of total TA earnings in a particular TA industry are taken to indicate the proportion of GDP in that particular TA industry. There are strengths and weaknesses to this approach that will impact different industries differently according, essentially, to how well earning shares represent GDP shares and how these representations or relationships between GDP and earnings differ across industries. It is also noteworthy that self-employment earnings are not included, this is because self-employment earnings can be negative, which will not be truly representative of GDP output. MBIE intends to evaluate further how self-employment might also be included to better represent the allocation of GDP by industry in future analysis. The differing relationship of earnings to GDP across industries will also impact on the different total TA GDPs in different directions.

IPF adjusts the earnings of TA industries so that they sum up to corresponding Regional Council industry GDP totals as published by Stats NZ in their Regional GDP series (and in a custom Regional GDP table Stats NZ supplies to MBIE that gives a finer degree of industry breakdown). As with the Regional GDP series, the industry breakdown is available for every year except the latest published year. The latest year for Regional GDP is considered provisional, as the full suite of underlying data for determining the value of Regional GDP is not completely available to Stats NZ at time of publication. All years, including the provisional year, can be subject to Stats NZ revisions in later releases (revisions which will impact directly on the MTAGDP series).

Due to the unavailability of custom Annual LEED data for the latest Regional GDP year (currently 2017) and that the Regional GDP series does not publish an industry breakdown for the latest published year, the MTAGDP series does not include TA GDP by industry estimates for the latest year either. However, ARIMA (autoregressive integrated moving average) forecasting has been employed to generate the provisional total GDP for the latest year for each TA. IPF is applied again to make sure these TA MTAGDP estimates match published Regional GDP totals for Regional Councils.

2.2 Main data sources

An overview of the data sources and the level of detail associated with each include:

ID	Data set	Description
D01	Custom Annual LEED workplace table	Provides Annual LEED earnings (wage and salaries) for people at their primary place of work by Territorial Authority and ANZSIC06 industry groups (source is Stats NZ).
D02	Custom Regional GDP table	Provides published Regional GDP (15 regions) but with finer industry classification (32 industries) (source is Stats NZ).
D03	Published Regional GDP by industry	Provides published Regional GDP by industry division. Sourced from Infoshare: Regional Gross Domestic Product - RNA: Gross domestic product, by region and industry (Annual-Mar).
D04	National GDP by industry (Production Measure), Nominal	Provides nominal (current price) GDP with more detailed industry breakdown than Regional GDP but without regional information. Sourced from Infoshare: National Accounts - SNA 2008 - SNE: Series, GDP (P), Nominal, Actual, ANZSIC06 industry groups (Annual-Mar).
D05	National GDP by industry (Production Measure), Real	Provides real (inflation adjusted) GDP with more detailed industry breakdown than Regional GDP but without regional information. Sourced from Infoshare: National Accounts - SNA 2008 - SNE: Series, GDP(P), Chain volume, Actual, ANZSIC06 industry groups (Annual-Mar).
D06	National GDP Total (Production Measure), Nominal	Provides nominal GDP without industry or regional breakdowns. Sourced from Infoshare: National Accounts - SNA 2008 - SNE: Series, GDP (P), Nominal, Actual, Total (Annual-Mar).
D07	National GDP Total (Production Measure), Real	Provides real GDP without industry or regional breakdowns. Sourced from Infoshare: National Accounts - SNA 2008 - SNE: Series, GDP(P), Chain volume, Actual, Total (Annual-Mar)
D08	Estimated resident population for territorial authorities	Provides estimated resident population at Territorial Authority level. Sourced from Infoshare: Population - Population Estimates – DPE: Estimated Resident Population for Territorial Authority Areas, at 30 June(1996+) (Annual-Jun)
D09	Estimated resident population for regional councils and whole of New Zealand	Provides estimated resident population at Regional Council level. Sourced from Infoshare: Population - Population Estimates – DPE: Estimated Resident Population for Regional Council Areas, at 30 June (1996+) (Annual-Jun)

2.3 Modelling process

The modelling process starts with the custom Annual LEED table (D01) that provides the detailed earnings (wages and salaries) data for TAs and ANZSIC06 industry groups. This data is scaled up (or 'raked') to the GDP totals for the Regional Councils and industry divisions published in Stats NZ's Regional GDP series (D03) using iterative proportional fitting (IPF). To achieve more accurate estimates for finer industry categories, the data is also scaled to a custom Regional GDP table (D02) supplied by Stats NZ that has finer industry group disaggregation.

The detailed steps are:

1. Prepare the custom Annual LEED earnings table (D01) to take an appropriate shape, with the TAs mapped to the published Regional GDP RCs, and the ANZSIC06 industry groups mapped to both published Regional GDP industry divisions and custom Regional GDP industry groups.
2. Rake the values (earnings) in the custom Annual LEED table (D01) to the GDP totals provided by the published Regional GDP by industry table (D03), at the RC level for the TA totals, at the published Regional GDP industry level for the industry divisions, and for each year in the published Regional GDP series. This will produce GDP estimates consistent with the published Regional GDP by RC by industry results.
3. Rake the values created in the previous step to the totals provided by the custom Regional GDP table (D04), at the RC level for the TAs totals, at the custom Regional GDP industry group level (32 industry categories) for industry, and for each year in the time series. This will fine-tune the TA GDP estimates by industry group to match the values provided by the custom Regional GDP by industry group table.

2.4 Forecasting

Once the modelling/IPF process is complete there will be GDP total and industry estimates for all TAs, RCs and New Zealand up to the year before the latest published Regional GDP provisional year (the RC totals and RC industry totals and NZ totals will match the official published annual nominal GDP series, as they are the target totals raked to). The provisional total GDP for each RC means it is also possible to apply a forecasting technique that extends the total TA GDP series of MTAGDP to that latest year.

The detailed steps are:

1. An autoregressive integrated moving average (ARIMA) forecasting procedure is applied to forecast the total TA GDP estimates to the latest available provisional year in published Regional GDP (the year for which industry breakdown is not published).
2. The forecast 2017 total TA GDP results are raked to the published Regional GDP RC totals. The raked 2017 total TA GDP results become the provisional total TA GDP estimates for TAs.

Note that the latest year provisional estimates do not include the industry breakdowns and should be used with caution given they are based on provisional totals and do not incorporate any shift in the share of GDP between TAs (as this is provided by the custom Annual LEED earning data that is not available for the latest year).

2.5 Inflation adjustment

The annual MTAGDP estimates produced in the previous modelling process are nominal. To produce annual real GDP estimates industry-level deflators are calculated from the published nominal and real national GDP by industry series (D04-D07) for each of the required years and for each of the 32 industry groups. These are applied to the estimated industry MTAGDP totals for TAs and RCs. The industry-level (and total) GDP adjustments for inflation are identical across all the regions (RCs and TAs).

Although most of the industry categories in the national GDP tables (D04-D07) match those in the custom Regional GDP table (D02), there are a few exceptions. Therefore, the following adjustments are applied:

1. The deflator calculated for the 'Accommodation and Food Services' industry used in the national GDP tables is used for both the 'Accommodation' and the 'Food and beverage services' industries used in the custom Regional GDP table.
2. The 'Local Government Administration' and 'Central Government Administration, Defence and Public Safety' industry groups in the national GDP tables are combined to calculate the deflator for the 'Public administration and safety' industry group used in Regional GDP.

Note that, due to the nature of the chain-linked approach used in the official real GDP series, the additivity of industry breakdown to total GDP has been lost (see Chain volume measures in National Accounts — "*There also exist disadvantages to chainlinking. Comparisons between non-adjacent periods become more difficult to interpret. Chainlinking also causes loss of additivity in the series - the chainlinked value for an aggregate will not equal the sum of the chainlinked values of its components. This could pose serious difficulties for some users.*"). Therefore some discrepancies between the total real GDP and the sum of all real GDP industry breakdowns in the real (inflation adjusted) MTAGDP series are to be expected.

2.6 Per capita measures

The MTAGDP series provides estimates of both nominal GDP per capita and real GDP per capita for each TA and RC. Sub-national population estimates published by Stats NZ are used to calculate per capita values.

3. Changes from the previous methodology

3.1 Quarterly LEED and BDS data replaced by custom Annual LEED data

In previous releases, three published Quarterly Linked Employer-Employee Database (LEED) tables and data from the Business Demography Statistics (BDS) were used to obtain earnings data by combined RC and TA regions and ANZSIC06 industry groups. Since none of them individually reached the desired level of granularity in both regions and industries, the tables were combined to give an estimate of the earnings by TA and industry.

Data set	Description
QTR LEED Table 4	1-Way: LEED measures (total earnings) by industry (ANZSIC06 industry group).
QTR LEED Table 37	1-Way: LEED measures (total earnings) by Territorial Authority.
QTR LEED Table 18	2-Way: LEED measures (total earnings) by industry (ANZSIC06 division) and region (RC).
BDS	Geographic units (and employee counts) by region (RC and TA) and industry

	(ANZSIC06 group).

For the MTAGDP 2018 methodology update, a custom Annual LEED table with earnings by TA and detailed level 3 ANZSIC-06 industry group was available. This provided a more accurate and convenient data source for the subsequent modelling procedure.

3.2 Remove the input from Business Demography Statistics (BDS)

In previous releases, employee numbers in the Business Demography Statistics (BDS) were used for fine grained allocations within industries when earnings were not available at the necessary level of a granularity.

In this release (year ended March 2017), the level of granularity of the custom LEED table is sufficient, and the BDS table is not needed any more.

3.3 Remove the commuter correction procedure

Earnings in the custom Annual LEED table provided by Stats NZ are allocated to the territorial authorities where the business locates, so there is no need to apply a commuter correction. The removal of this procedure creates a variation between historical MTAGDP results and the post-revision methodology MTAGDP results for some TAs where high commuter flows are a factor. The variation is essentially more accurately allocating GDP to the TAs where it belongs.

3.4 Changes in the reported industry categories

In previous releases, two classifications of industry categories were reported: one consistent with the 18 higher level industry categories published in the Regional GDP series, and another one with the 56 industry categories published in Stats NZ's National accounts (e.g. National Accounts - SNA 2008 - SNE: Series, GDP(P), Nominal, Actual, ANZSIC06 detailed industry groups (Annual-Mar) in Infoshare).

In this release, the number of categories in the higher level industry classification increased one to 19, reflecting the Regional GDP breakdown of Accommodation and Food Services into two separate categories: Accommodation, and, Food Services.

The other, 56-industry classification, is replaced by a classification with 32 industry categories that is consistent with the custom Regional GDP dataset provided to MBIE by Stats NZ. , and is at similar level as the 'ANZSIC06 industry groups' of Stats NZ National accounts (industry production and investment) (32 industry categories, as shown in Infoshare table 'National Accounts - SNA 2008 - SNE: Series, GDP(P), Nominal, Actual, ANZSIC06 industry groups (Annual-Mar)').

4. Definitions and concordances for geographical area and industry

One of the key elements in the derivation of MTAGDP lies in concording different levels of geographical area and industry group to those used in Stats NZ published data.

4.1 Geographical Area

The custom Annual LEED earnings data is at the Territorial Authority (TA) level, while the desired output includes the standard regional council area (Region) as well as the published Regional GDP area (RGDP Region). A concordance table is needed to map these three geographical area classifications to each other.

The mapping from Region to RGDP Region simply combines Tasman and Nelson to Tasman/Nelson.

However, when matching TA to Region, there is a challenge is the lack of a strict hierarchy between the classifications. TAs are not strict sub-divisions of Regions, and some of them fall within more than one Region. Therefore, the contributions of these TAs to each Region needs to be specified. To overcome this difficulty, a geographic area-based proportional allocation approach has been adopted.

Table 1 shows the concordance between TA, Region to RGDP Region, and the proportions of the TA contributing to Region.

TA	Region	Proportion	RGDP_Region
Far North District	Northland	1	Northland
Whangarei District	Northland	1	Northland
Kaipara District	Northland	1	Northland
Auckland	Auckland	1	Auckland
Auckland	Auckland	1	Auckland
Auckland	Auckland	1	Auckland
Auckland	Auckland	1	Auckland
Auckland	Auckland	1	Auckland
Auckland	Auckland	1	Auckland
Auckland	Auckland	1	Auckland
Thames-Coromandel District	Waikato	1	Waikato
Hauraki District	Waikato	1	Waikato
Waikato District	Waikato	1	Waikato
Matamata-Piako District	Waikato	1	Waikato
Hamilton City	Waikato	1	Waikato
Waipa District	Waikato	1	Waikato
Otorohanga District	Waikato	1	Waikato
South Waikato District	Waikato	1	Waikato

Waitomo District	Waikato	0.9487	Waikato
Waitomo District	Manawatu-Whanganui	0.0513	Manawatu-Whanganui
Taupo District	Waikato	0.7374	Waikato
Taupo District	Bay of Plenty	0.1431	Bay of Plenty
Taupo District	Hawke's Bay	0.1126	Hawke's Bay
Taupo District	Manawatu-Whanganui	0.0069	Manawatu-Whanganui
Western Bay of Plenty District	Bay of Plenty	1	Bay of Plenty
Tauranga City	Bay of Plenty	1	Bay of Plenty
Rotorua District	Bay of Plenty	0.6152	Bay of Plenty
Rotorua District	Waikato	0.3848	Waikato
Whakatane District	Bay of Plenty	1	Bay of Plenty
Kawerau District	Bay of Plenty	1	Bay of Plenty
Opotiki District	Bay of Plenty	1	Bay of Plenty
Gisborne District	Gisborne	1	Gisborne
Wairoa District	Hawke's Bay	1	Hawke's Bay
Hastings District	Hawke's Bay	1	Hawke's Bay
Napier City	Hawke's Bay	1	Hawke's Bay
Central Hawke's Bay District	Hawke's Bay	1	Hawke's Bay
New Plymouth District	Taranaki	1	Taranaki
Stratford District	Taranaki	0.6813	Taranaki
Stratford District	Manawatu-Whanganui	0.3187	Manawatu-Whanganui
South Taranaki District	Taranaki	1	Taranaki
Ruapehu District	Manawatu-Whanganui	1	Manawatu-Whanganui
Whanganui District	Manawatu-Whanganui	1	Manawatu-Whanganui
Rangitikei District	Manawatu-Whanganui	0.8637	Manawatu-Whanganui
Rangitikei District	Hawke's Bay	0.1363	Hawke's Bay
Manawatu District	Manawatu-Whanganui	1	Manawatu-Whanganui
Palmerston North City	Manawatu-Whanganui	1	Manawatu-Whanganui
Tararua District	Manawatu-Whanganui	0.9842	Manawatu-Whanganui
Tararua District	Wellington	0.0158	Wellington
Horowhenua District	Manawatu-Whanganui	1	Manawatu-Whanganui
Kapiti Coast District	Wellington	1	Wellington
Porirua City	Wellington	1	Wellington
Upper Hutt City	Wellington	1	Wellington
Lower Hutt City	Wellington	1	Wellington
Wellington City	Wellington	1	Wellington
Masterton District	Wellington	1	Wellington
Carterton District	Wellington	1	Wellington
South Wairarapa District	Wellington	1	Wellington
Tasman District	Tasman	1	Tasman/Nelson
Nelson City	Nelson	1	Tasman/Nelson
Marlborough District	Marlborough	1	Marlborough
Kaikoura District	Canterbury	1	Canterbury
Buller District	West Coast	1	West Coast

Grey District	West Coast	1	West Coast
Westland District	West Coast	1	West Coast
Hurunui District	Canterbury	1	Canterbury
Waimakariri District	Canterbury	1	Canterbury
Christchurch City	Canterbury	1	Canterbury
Christchurch City	Canterbury	1	Canterbury
Selwyn District	Canterbury	1	Canterbury
Ashburton District	Canterbury	1	Canterbury
Timaru District	Canterbury	1	Canterbury
Mackenzie District	Canterbury	1	Canterbury
Waimate District	Canterbury	1	Canterbury
Christchurch City	Canterbury	1	Canterbury
Waitaki District	Canterbury	0.5961	Canterbury
Waitaki District	Otago	0.4039	Otago
Central Otago District	Otago	1	Otago
Queenstown-Lakes District	Otago	1	Otago
Dunedin City	Otago	1	Otago
Clutha District	Otago	1	Otago
Southland District	Southland	1	Southland
Gore District	Southland	1	Southland
Invercargill City	Southland	1	Southland

4.2 Industry categories

Apart from the geographic dimension, MTAGDP also provides more disaggregated industry breakdowns. The higher level industry classification (19 industry categories) used in the published Regional GDP series have been adopted by MTAGDP, and reported as RGDP_industry. A more detailed industry classification (32 industry categories) is also reported in MTAGDP, named as RGDP_industry_detail.

The concordance between RGDP_industry and RGDP_industry_detail is shown below.

RGDP_industry	**RGDP_industry_detail**
Accommodation	Accommodation
Administrative and Support Services	Administrative and Support Services
Agriculture	Agriculture
Construction	Construction
Education and Training	Education and Training
Financial and Insurance Services	Financial and Insurance Services
Food and beverage services	Food and beverage services
Forestry, Fishing, Mining, Electricity, Gas, Water and Waste Services	Electricity, Gas, Water and Waste Services
Forestry, Fishing, Mining, Electricity, Gas, Water and Waste Services	Fishing, Aquaculture and Agriculture, Forestry and Fishing Support Services
Forestry, Fishing, Mining, Electricity, Gas, Water and Waste Services	Forestry and Logging

Forestry, Fishing, Mining, Electricity, Gas, Water and Waste Services	Mining
GST on production, import duties, and other taxes	GST on production, import duties, and other taxes
Health Care and Social Assistance	Health Care and Social Assistance
Information Media, Telecommunications and Other Services	Arts and Recreation Services
Information Media, Telecommunications and Other Services	Information Media and Telecommunications
Information Media, Telecommunications and Other Services	Other Services
Manufacturing	Food, Beverage and Tobacco Product Manufacturing
Manufacturing	Furniture and Other Manufacturing
Manufacturing	Metal Product Manufacturing
Manufacturing	Non-Metallic Mineral Product Manufacturing
Manufacturing	Petroleum, Chemical, Polymer and Rubber Product Manufacturing
Manufacturing	Printing
Manufacturing	Textile, Leather, Clothing and Footwear Manufacturing
Manufacturing	Transport Equipment, Machinery and Equipment Manufacturing
Manufacturing	Wood and Paper Products Manufacturing
Owner-Occupied Property Operation	Owner-Occupied Property Operation
Professional, Scientific and Technical Services	Professional, Scientific and Technical Services
Public Administration and Safety	Public administration and safety
Rental, Hiring and Real Estate Services	Rental, Hiring and Real Estate Services
Retail Trade	Retail Trade
Transport, Postal and Warehousing	Transport, Postal and Warehousing
Wholesale Trade	Wholesale Trade